ENDODERMAL FLAGELLA OF *HYDRA OLIGACTIS* PALLAS.

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The subject of flagella upon the endodermal cells of hydra was first opened prior to 1871 by Hatchek, who figured a single tapering flagellum upon each cell, all of which he considered similar. F. E. Schulze ('71), figured a single flagellum to each cell of an optical section of a tentacle. Kleinenberg ('72) in transverse sections of the living animal observed one or more flagella in connection with several cells and claimed that the flagella were not fixed structures but that they could be protruded and retracted again, while at the same time the cells sent out pseudopodial processes. T. J. Parker ('80) saw one, two, or three cilia on cell after cell. Because of this observation he drew the inference that the endoderm was ciliated throughout. K. C. Schneider ('90) distinguished at least six types of endodermal cells; but he stated that only three of these types bore flagella. The digestive or epithelio-muscular cells usually bear two flagella, which project into the enteron. The glandular cells bear two or three flagella. The sensory cells bear one, two or no flagella. Schneider gave us, therefore, the first proper description of the flagellated condition of hydra's endoderm. Hadzi ('09) did not carry the knowledge of the flagellated condition of the endoderm beyond Schneider. I have been able to corroborate the work of Schneider and to carry his observations a step further by the use of the following method.

Hydra oligactis was macerated by Mundie's ('26) method. In this case a hydra was placed upon a slide and the water drawn off until but a film remained covering the polyp. The slide was then placed over the mouth of a bottle containing Looper's fixing fluid (made up of equal parts of 95 per cent. alcohol, glacial acetic acid and 40 per cent. formalin [1]). At the end of eight or ten minutes

[1] This method was developed in this laboratory by Dr. J. B. Looper.

the polyp was rinsed in one or two drops of water, as much of this water as possible drawn off and a drop of Gramm's iodine solution added. The polyp was teased into fragments with needles, a drop of 40 per cent. glycerine added and a coverglass applied. The fragments were then examined under the oil immerson objective. Being in glycerine, the cells could be preserved for a relatively long time, a month or more. During this time the flagella persisted and the cells did not deteriorate. The tissues may even be further treated. For example, if the iodine fades, more iodine may be drawn beneath the coverglass. I have also carried one per cent eosin-licht gruen (95 per cent. alcoholic) solution beneath the coverglass and have, in this manner, stained nuclei, food vacuoles, flagella and other details well. In passing it may be stated that the use of the licht-gruen solution brings out conspicuously the pseudopodia of the epithelio-muscular cells of the endoderm.

The epithelio-muscular cells are columnar. A myoneme runs at right angles to the polyp's axis through their broad bases. The distal end bears one or more flagella. There are many food vacuoles in epithelio-muscular cells from well-fed specimens. The secreting cells of the general endoderm are club shaped with the smaller end directed toward the mesoglea. The distal end bears one or two flagella. The distal half of the cell is much vacuolated and in well-fed specimens these vacuoles contain darkly staining material called by Schneider, "Sekretballen." The basal end is darkly granular and bears no myoneme. The sensory cells are of the tall columnar type—almost filamentous. Each contains an ellipsoidal nucleus. These cells bear at their bases slender nodulated processes similar to those figured by Hadzi, in Table II., Fig. 7 and 8. In this type of cell we encountered a flagellum as did Schneider (Fig. 3).

I now come to the point at which my work goes beyond the work of Schneider upon the flagella of hydra. Some of the investigators describe the flagella as being tapering protoplasmic processes. Schneider shows them to be slender and of uniform caliber from base to tip. He does not, however, show a structure that is typically found associated with a flagellum, vis., a blepharoplast. All of my preparations show the flagella of epithelio-mus-

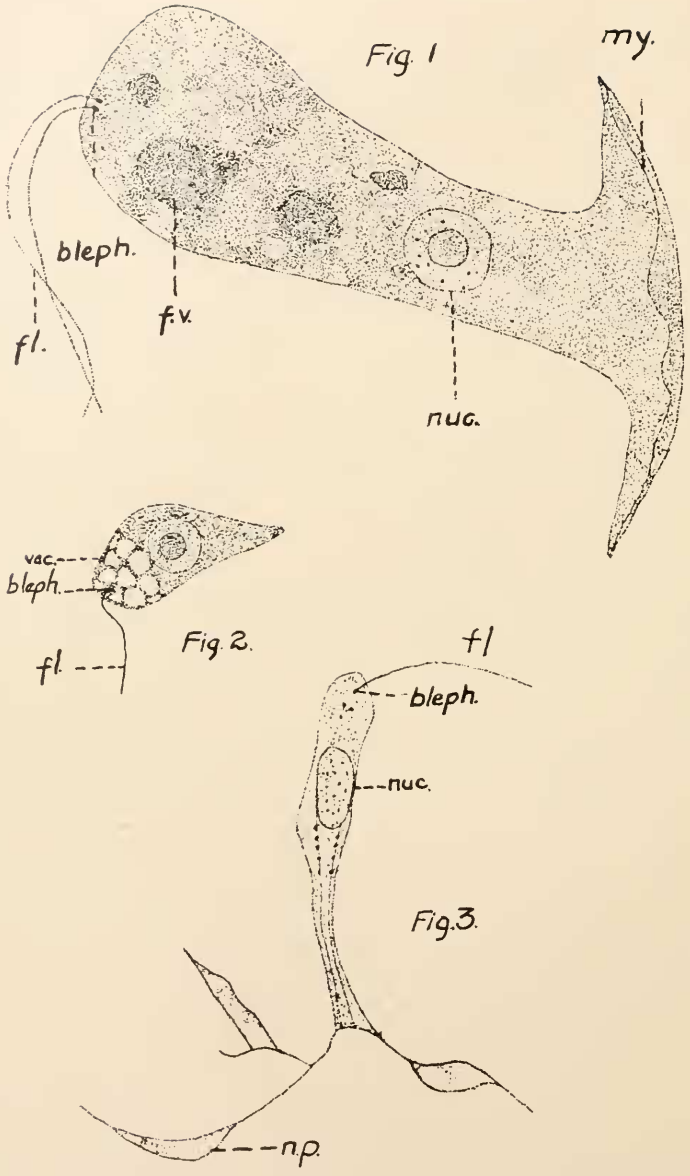

FIG. 1. Epithelio-muscular cell; *bleph.*, blepharoplast; *fl.*, flagellum; *fv.*, food-vacuole; *my.*, myoneme; *nuc.*, nucleus. × 1000.

FIG. 2. Secreting cell.

FIG. 3. Sensory cell; *np.*, nodulated process.

cular cells, glandular cells, and sensory cells to be associated with a blepharoplast. My Fig. 1 is of an epithelio-muscular cell that shows two flagella each extending into the cell's cytoplasm and ending upon a blepharoplast (Fig. 1, *bleph*). Fig. 2 shows, likewise, that in a secreting cell the flagellum enters the cytoplasm and ends upon a blepharoplast. Finally Fig. 3 indicates that the flagellum of a sensory cell enters the cytoplasm and terminates in a blepharoplast.

Summary.

The cells of hydra's endoderm—epithelio-muscular, secreting, and sensory—are flagellated. The flagella are typical in that they are non-tapering lash-like processes which terminate in blepharoplasts.

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